Relationships Between Depression, Obesity, and Physical Fitness In University Students

Troy Lee Kuster, Jr.
Illinois State University, tj.kusterjr@gmail.com

Follow this and additional works at: http://ir.library.illinoisstate.edu/etd

Recommended Citation
Kuster, Jr., Troy Lee, "Relationships Between Depression, Obesity, and Physical Fitness In University Students" (2014). Theses and Dissertations. Paper 155.
RELATIONSHIPS BETWEEN DEPRESSION, OBESITY, AND PHYSICAL FITNESS IN UNIVERSITY STUDENTS

Troy L. Kuster Jr.

The United States has witnessed an alarming rise in overweight and obesity within the past twenty years. It is currently estimated that two-thirds of the population is now overweight with one-third being obese. In conjunction with obesity, the United States has also seen an increase in depression in recent years which is defined as feelings of intense sadness, which include feelings of hopelessness, helplessness, and worthlessness that can last from many days to many weeks keeping an individual from functioning normally. One major contributing factor to both of these issues may be a lack of physical activity. The purpose of this study was to compare fitness and adiposity scores in individuals who were classified as depressed, or non-depressed. The data for this study was drawn from an Illinois State University archive data using past Kinesiology and Recreation Personal Fitness (KNR 113) students (n=141). Subjects were assessed for depression via the Beck Depression survey, obesity via body mass index (BMI), body fat percentage (BF%), and waist to hip ratio (W/H). Cardiovascular fitness was assessed utilizing a one mile walk test which was converted into a maximal oxygen uptake (VO2 max). Muscular strength and endurance was assessed by maximal push-up
and sit-up tests. Results showed no differences in sex between low depression (LD) and moderate depression (MD) groups. Significant differences between low depression and moderate depression groups were found in BMI (LD = 23.75) (MD = 25.42) and BF% (LD = 22.23%) (MD = 26.05%). No significant differences were found in muscular strength and endurance, cardiovascular fitness, or W/H between low depression and moderate depression groups. It is concluded that BMI and BF% is associated with higher depression scores in both men and women, yet there is no association between depression status and physical activity scores.
RELATIONSHIPS BETWEEN DEPRESSION, OBESITY, AND PHYSICAL FITNESS IN UNIVERSITY STUDENTS

TROY L. KUSTER JR.

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE

School of Kinesiology and Recreation

ILLINOIS STATE UNIVERSITY

2014
RELATIONSHIPS BETWEEN DEPRESSION,
OBESITY, AND PHYSICAL FITNESS
IN UNIVERSITY STUDENTS

TROY LEE KUSTER JR.

COMMITTEE MEMBERS:
Dale Brown, Chair
Kristen Lagally
Karen Dennis
Kelly Laurson
# CONTENTS

CONTENTS

CONTENTS \hspace{1cm} i

TABLES \hspace{1cm} ii

CHAPTER

I. THE PROBLEM AND ITS BACKGROUND \hspace{1cm} 1

Introduction \hspace{1cm} 1
Methodology \hspace{1cm} 3
Data/Statistical Analysis \hspace{1cm} 6
Results \hspace{1cm} 7
Discussion \hspace{1cm} 8
References \hspace{1cm} 13

II. REVIEW OF RELATED LITERATURE \hspace{1cm} 15

Introduction \hspace{1cm} 15
Part I. Physical Inactivity and Obesity \hspace{1cm} 19
Part II. Physical Inactivity and Depression \hspace{1cm} 24
Part III. Obesity and Depression \hspace{1cm} 35
Part IV. Physical Inactivity, Depression, and Obesity \hspace{1cm} 47
Summary \hspace{1cm} 50
References \hspace{1cm} 52

APPENDIX: Trifit Depression Survey Questions \hspace{1cm} 54
TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Descriptive Statistics of the Study Sample</td>
<td>11</td>
</tr>
<tr>
<td>2. Test Scores for Low and Moderate Depression Groups</td>
<td>11</td>
</tr>
</tbody>
</table>
CHAPTER I
THE PROBLEM AND ITS BACKGROUND

Introduction

The United States has witnessed an alarming rise in overweight and obesity within the past twenty years. It is currently estimated that two-thirds of the population is now overweight with one-third of these obese. This condition, classified as having a body mass index (BMI) of $\geq 25$ kg/m$^2$ (overweight) or $\geq 30$ kg/m$^2$ (obese) puts an incredible strain on the body which predisposes individuals who are obese to a greater risk for chronic diseases that typically accompany obesity and can eventually develop in individuals who are obese. The estimated annual health care costs of obesity-related illness are a staggering $190.2$ billion, or nearly $21\%$ of annual medical spending in the United States (8).

In conjunction with obesity, the United States has also seen an increase in depression in recent years according to the Center for Disease Control. Depression is defined as feelings of intense sadness, which include feelings of hopelessness, helplessness, and worthlessness that can last from many days to many weeks keeping an individual from functioning normally (6,11). Depression has been identified as one of the future risk factors in the health of older adults, and has a lifetime prevalence of $16\%$ as indicated in a recent U.S. National Comorbidity Survey Replication sample (13). Medical conditions that have been recently linked with depression include chronic headaches,
back pain, muscle aches, joint pain, digestive problems, chest pain, trouble sleeping, exhaustion, fatigue, and changes in weight.

One of the major factors that appear to have influence over these two disorders is physical inactivity (1, 4, 5, 6, 9). Physical inactivity causes a variety of physiological and psychological effects that greatly influence body composition as well as mood (1,10,13,15). Recent research has also indicated that the type of physical activity individuals engage in effects mood drastically. Amongst individuals that are physically active, it appears that those who engage in resistive exercise may have a more positive self-concept than those who engage in solely aerobic training (16).

Although research has been performed assessing the affects of physical inactivity and obesity, physical inactivity and depression, and obesity and depression, relatively few studies have examined the relationship between depression, obesity, and fitness scores. How does one’s physical fitness effect depression and obesity? Obese individuals may be more likely to become depressed due to dissatisfaction with their appearance and the social stigmatization associated with obesity (6). Those who are depressed could likely become obese due to physiological and psychological changes which could in turn slow down their metabolism and affect activity levels (12).

Unfortunately the research is lacking as to the combined effect depression could have on adiposity and fitness levels. Although individuals may know that exercise is beneficial for their health, if they are too depressed to initially engage in physical activity then just having the knowledge of what would be beneficial to their health may not enough to motivate them. As a result, health care providers would benefit patients by being able to understand their condition and figure out ways to make exercise a reality for
depressed individuals. Without understanding the interaction of these physical and emotional components; it is difficult to know how to best create appropriate holistic intervention programs to address depression, obesity, and the lack of physical activity that is currently impacting us individually and nationally on economic, social, and psychological levels.

The purpose of this study was to compare fitness and adiposity scores in individuals who had different levels of risk for depression. It is hypothesized that individuals classified in the low depression group would score lower on BMI and body fat percentage, and waist to hip ratio, while higher on fitness scores compared to the moderately depressed individuals.

**Methodology**

*Subjects & Procedures.* Each semester the School of Kinesiology and Recreation offers general education courses to students of all majors at Illinois State University. The Personal Fitness course (KNR 113) is a very popular class with multiple sections offered each semester. The class has a lecture/lab format where students learn content knowledge but also apply what they are learning through hands-on application. The curricular approach to the class also includes physical assessments, wellness screenings, health risk profile analysis, etc. Those assessments, screenings and profile analysis for this class occur within the first 2 to 3 weeks of the start of the course. These assessments are conducted in the KNR Exercise Physiology Laboratory by trained staff. Once all the assessments and screenings are completed, the results are entered into a secured database, by the student, using the Polar/HealthFirst Trifit Software System. Prior to any of the assessments and screenings subjects read and signed an informed consent, medical
history, PAR-Q, research release, and liability form. The Health Insurance Portability and Accountability Act (HIPPA) regulations are strictly followed. Only upon receipt of the completed/signed forms are students allowed to participate in any study. Procedures and protocols have been reviewed and approved by the institutional review board at Illinois State University.

Data for this project came from the records of students previously enrolled or currently enrolled in the KNR Personal Fitness course (KNR 113). The database currently contains student records from the fall of 2011 through spring 2014. The number of subjects included was 141. Subjects were grouped based on depression score. The groups were classified into either low depression (LD) (n = 83), or moderate depression (MD) (n = 58). The data included in this project were the student records that had completed all the required assessments and screenings. Only those subjects contained within the Polar/HealthFirst Trifit Software database, who gave permission/research release for their KNR 113 data to be used for research purposes, were included.

Assessments and Screenings: The following section is a description of the procedures used during the assessments and screenings that are conducted for students as part of the KNR 113 Personal Fitness class.

*Body Mass Index Assessment and Waist Circumference.* For the measurement of body mass index, stature (meters) and mass (kilograms) were measured, and then body mass index (BMI) was calculated as body mass divided by stature squared. Waist circumference was measured by locating the upper hip bone and the top of the right iliac crest and placing a measuring tape in a horizontal plane around the abdomen at the level
of the iliac crest. The tape was pulled snug, but did not compress the skin, and was parallel to the floor. The measurement was made at the end of a normal expiration.

**Body composition assessment.** Body mass and composition were assessed using the Tanita body composition analyzer (TBF-300A). Clothing weight was estimated for the subjects and each participant’s gender, age and height were manually entered into the keypad interface of the Tanita analyzer. Since the Tanita body composition analyzer has two stainless-steel foot electrodes mounted on platform scale, each subject was asked to remove their shoes and socks before being tested (as per manufacturer’s instructions). After subject demographic data (age, gender, and height) was entered into the Tanita body composition analyzer, subjects were instructed to step onto the analyzer and place the ball and heel of each foot appropriately on to the foot-pads of the analyzer. Weight was measured on the scale and body fat percentage was determined by the analyzer utilizing bio-impedance technology. The results from the Tanita body composition analysis were recorded and subsequently entered into a computer for data analysis.

**Physical Fitness Assessments.** Physical fitness assessments were conducted as a routine part of the student’s academic class. Fitness assessments were made by the trained staff of the KNR Exercise Physiology Lab. Assessments of cardiovascular fitness were made using the Rockport One Mile Walk Test. This test required the subjects to walk one mile as fast as they could. After they completed the mile, subjects immediately assessed their heart rate. The heart rate and time of the mile walk was then entered into the Polar/HealthFirst Trifit Software which calculated their estimated maximal oxygen uptake using the Rockport equations. Muscular strength and endurance were tested using
the timed sit up and maximal push-up tests. Data from each of these assessments was recorded and entered into the Polar/HealthFirst TriFit Software database.

Depression. Assessment of depression was made using the Beck Depression Inventory contained within the health risk appraisal of the Polar/HealthFirst TriFit Software system. The Beck Depression Inventory provides a systematic approach to collecting information related to one’s risk for depression and demonstrates high internal consistency, with alpha coefficients of 0.86 and 0.81 for psychiatric and non-psychiatric populations respectively (2). Students answered twenty questions that provided a basis for the determination of their risk for developing diseases related to that health risk. The questionnaire is designed for individuals aged 13 and over, and is composed of items relating to symptoms of depression such as hopelessness and irritability, cognitions such as guilt or feelings of being punished, as well as physical symptoms such as fatigue, weight loss, and lack of interest in sex. The results obtained on the questions within the depression health risk appraisal allowed for subjects to be classified as low, mild, moderate or severe depression. A listing of the questions asked in the depression health risk appraisal are included in Appendix A.

Data/Statistical Analysis

All of the data/variables of interest in this study were exported out of the Polar HealthFirst TriFit system into a Microsoft Excel file. The data was examined for completeness and accuracy by visual inspection of the scores. The data was then imported into SPSS which was used to generate basic descriptive statistics for the subjects by sex and depression classifications for the variables of interest in this study (BMI, body fat percentage, and the components of physical fitness). With the data
grouped by sex and depression classifications a multivariate analysis was utilized to examine the sex and depression interaction and simple main effects for both sex and depression.

**Results**

The characteristics of the participants are presented in Table 1. The subjects consisted of 81 females and 60 males from general fitness courses at a large Midwestern university. The mean age for females was 21.3 (± 0.3) years and 21.1 (± 0.3) years for the males. The mean height was 65.1 (± 0.3) and 70.4 (± 0.4) inches for with a mean weight of 143.6 (± 3.5) and 180.3 (± 4.0) pounds for females and males respectively.

Multivariate analysis showed no statistically significant sex and depression interaction. The results were then examined for statistically significant main effects for both sex and depression. Given that it is expected that there would be statistically significant main effect differences between males and females, the main effect for depression became the statistical analysis of most interest in this study. Statistically significant differences were found for BMI values between the low depression (LD) and moderate depression (MD) groups with the LD group having a BMI of 23.75 ± 3.46 (normal weight) and the MD group having BMI of 25.42 ± 5.25 (overweight). Significant difference were also found in body fat percentage with the LD group having a body fat percentage of 22.23% ± 8.85) and the MD group having a body fat percentage of 26.05% ± 11.32. No significant differences were found in muscular strength and endurance during the pushup and sit-up tests (LD max pushup = 32.34 ± 11.88; MD max pushup = 34.17± 18.46; LD max sit-up = 33.43 ± 8.79; MD max sit-up = 34.53 ± 11.04).
Cardiovascular fitness between the low depression and moderate depression groups also failed to show significant difference (LD VO2 max = 48.16 ± 7.43 ml/kg/min$^{-1}$; MD VO2 max = 47.66 ± 7.31 ml/kg/min$^{-1}$). Waist to hip ratio (W/H) failed to show significant difference between groups as well (LD W/H = 1.38 ± 1.26; MD W/H = 1.46 ± 1.57).

**Discussion**

The most important finding of the present study were the significantly higher BMI and body fat percentage values associated with higher depression scores in both men and women. While BMI values provide a good indication of the relationship between height and weight, it does not give any indication of body composition. The results of this study showing that body fat percentages were higher in the MD group indicates the increased adiposity associated with this group. Although BMI scores and depression appear to be related in some way; other dimensions of physical fitness (i.e. max pushup/max sit-up and VO2 max) were not significantly different between low depression and moderate depression groups. This is somewhat surprising because individuals with a lower body fat percentage are usually more fit than individuals with higher amounts of adiposity.

Another interesting find was the lack of significant difference between the low depression and moderate depression groups in the area of waist to hip ratio. Typically it would be expected that the waist to hip ratio would be significantly different if both BMI and body fat percentages differed between groups. It is speculated, however, that this lack of significance could be due to normal physiological differences in visceral adiposity between males and females.
The results of the association between depression and a higher BMI score agree with research performed by Herva et al. 2005 which concluded that obesity in adolescence might be associated with later depression among female subjects. Herva et al. 2005, also found that abdominal obesity among male subjects may be closely related to depression, and being overweight/obese both in adolescence and adulthood may be a risk factor for depression among female subjects.

The difference between this study and other studies performed was the lack of statistical difference in either cardiovascular fitness or muscular strength and endurance between the depressed and non-depressed groups, even though there was a difference in adiposity as indicated by increased BMI and body fat percentage scores. This difference is in contrast with Kontinnen et al. 2010 who found that depressed individuals had lower self-efficacy in maintaining physical activity. Both our study and Kontinnen et al. 2010, however, found higher BMI scores associated with depressed individuals. Lesser et al. 2012, noted that the higher one’s BMI, the lower their self-reported physical activity was. This is in contrast to the current study which noted no difference in physical fitness scores between obese and non-obese persons. It could be that the lack of statistical significance could be due to the sample from which the data was drawn. The Kinesiology and Recreation 113 course is a personal fitness course, whose physical assessment scores may not be representative of the general population.

It should be noted that the current study did not measure physical activity patterns between the two groups and only looked at physical fitness measures. It could be that subjects in this study who were in the MD group used exercise as a way to deal with their depression. As a result they may be equally as physically fit as the LD group.
Additionally, this study did not measure nutrition, diet, or food intake. It is entirely possible that the MD group, while engaged in physical activity to deal with depression, may have also compensated with eating more calories resulting in the differences observed in BMI and body fat percentages. As indicated by the American College Of Sports Medicine the fundamental determinant of body composition is the energy balance equation; so if the MD group consumed a larger quantity of calories relative to their energy expenditure in contrast to the LD group, it is entirely possible that they would then have a higher BMI and body composition percentage.

Another notable difference between our study and other existing literature, such as Carpenter et al. 2000, was the obesity scores associated with depression in men. Whereas Carpenter et al. 2000, discovered that a lower BMI in men was associated with depression and a higher BMI was associated with depression in women; we found that obesity had an equal impact on depression in both men and women. This contrasts the “Adonis Complex” which makes the assumption that men strive to become bigger and that a lower BMI is associated with being unmasculine (8).

Our study was limited due to its cross-sectional nature. Although we can draw associations between depression and obesity, we cannot say if they have a cause/effect or dose-response relationship. Our depression analysis questionnaire also limited us on knowing whether the subjects had previous bouts of depression, or were currently taking medication for their condition. Also, using a course entitled Personal Fitness may have its drawback with regards to bias and a convenience sample. Certainly there was a chance of having students taking the class that tend to be more interested in physical fitness.
Strengths of our study included the multivariate approach to examining obesity, physical fitness levels, and depression. The Polar Trifit Software allowed us to analyze both psychological health and physical health simultaneously with a set protocol to make sure all assessments were accurate. Other strengths include the measures of physical fitness and adiposity. BMI has shown to be accurate with an average population, and the sit-up and push up tests are routinely used by the military to assess upper body and core strength. Also, by adding VO2 max into our assessments, we were able to get a well-rounded idea of how fit each subject was.

Conclusion. The data from this study shows an association between adiposity and depression in both men and women; however we cannot draw correlations between these two variables due to this studies cross-sectional nature. We have also concluded that depression status did not have an impact on physical activity scores (ie. muscular strength/endurance, cardiovascular fitness) in either men or women. We speculate that this could be due to the KNR 113 course sample from which this study observed. In conclusion, our research agrees with past research in there being a relationship between obesity and depression. Future studies should focus on this relationship from a prospective perspective, and try to identify a sequential cause/effect pattern.
Table 1. Descriptive Statistics of the Study Sample (Mean ± S.D.)

<table>
<thead>
<tr>
<th>Description</th>
<th>Low Depression</th>
<th>Moderate Depression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male n =34</td>
<td>Female n = 49</td>
</tr>
<tr>
<td></td>
<td>Combined n = 83</td>
<td>Male n = 26</td>
</tr>
<tr>
<td></td>
<td>n = 34</td>
<td>Female n = 32</td>
</tr>
<tr>
<td></td>
<td>Combined n = 58</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>21.35 ± 1.63</td>
<td>20.86 ± 1.16</td>
</tr>
<tr>
<td></td>
<td>21.06 ± 1.38</td>
<td>20.92 ± 1.16</td>
</tr>
<tr>
<td>Height (in.)</td>
<td>71.01 ± 2.58</td>
<td>64.53 ± 2.52</td>
</tr>
<tr>
<td></td>
<td>67.19 ± 4.09</td>
<td>69.71 ± 3.42</td>
</tr>
<tr>
<td>Weight (lbs.)</td>
<td>172.79 ± 26.35</td>
<td>139.37 ± 21.10</td>
</tr>
<tr>
<td></td>
<td>153.06 ± 28.52</td>
<td>187.88 ± 45.60</td>
</tr>
</tbody>
</table>

Table 2. Test Scores of Low and Moderate Depression Groups (Mean ± S.D.)

<table>
<thead>
<tr>
<th>Test</th>
<th>Low Depression</th>
<th>Moderate Depression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male n =34</td>
<td>Female n = 49</td>
</tr>
<tr>
<td></td>
<td>Combined n = 83</td>
<td>Male n = 26</td>
</tr>
<tr>
<td></td>
<td>n = 34</td>
<td>Female n = 32</td>
</tr>
<tr>
<td></td>
<td>Combined n = 58</td>
<td></td>
</tr>
<tr>
<td>Sit-Up</td>
<td>39.06 ± 7.84</td>
<td>29.53 ± 7.20</td>
</tr>
<tr>
<td></td>
<td>33.43 ± 8.79</td>
<td>40.23 ± 10.31</td>
</tr>
<tr>
<td></td>
<td>40.23 ± 10.31</td>
<td>29.91 ± 9.48</td>
</tr>
<tr>
<td>Push-Up</td>
<td>39.44 ± 10.64</td>
<td>27.41 ± 10.14</td>
</tr>
<tr>
<td></td>
<td>32.34 ± 11.88</td>
<td>44.58 ± 19.51</td>
</tr>
<tr>
<td></td>
<td>44.58 ± 19.51</td>
<td>25.72 ± 12.45</td>
</tr>
<tr>
<td>BMI</td>
<td>24.03 ± 3.13</td>
<td>23.56 ± 3.69</td>
</tr>
<tr>
<td></td>
<td>23.75 ± 3.46*</td>
<td>26.98 ± 5.12</td>
</tr>
<tr>
<td></td>
<td>26.98 ± 5.12</td>
<td>24.15 ± 5.09</td>
</tr>
<tr>
<td>VO2 max</td>
<td>53.17 ± 6.59</td>
<td>44.69 ± 5.86</td>
</tr>
<tr>
<td></td>
<td>48.16 ± 7.43</td>
<td>52.60 ± 5.96</td>
</tr>
<tr>
<td></td>
<td>52.60 ± 5.96</td>
<td>43.65 ± 5.70</td>
</tr>
<tr>
<td>Percent Fat</td>
<td>14.28 ± 5.24</td>
<td>27.75 ± 6.25</td>
</tr>
<tr>
<td></td>
<td>22.23 ± 8.85*</td>
<td>21.10 ± 12.65</td>
</tr>
<tr>
<td></td>
<td>21.10 ± 12.65</td>
<td>30.07 ± 8.33</td>
</tr>
<tr>
<td>Waist to Hip</td>
<td>1.49 ± 1.97</td>
<td>1.31 ± 1.86</td>
</tr>
<tr>
<td></td>
<td>1.38 ± 1.26</td>
<td>1.64 ± 2.36</td>
</tr>
<tr>
<td></td>
<td>1.64 ± 2.36</td>
<td>1.31 ± 1.00</td>
</tr>
</tbody>
</table>

* Indicates significant difference
References


CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

Physical inactivity has become a recent phenomenon amongst western nations, and is slowly becoming a global epidemic. It appears to have a direct association with obesity and is often linked to depression amongst people of all ages. Developments in recent research have been noticing the effects of physical inactivity not only on obesity, but also on depression and how all three could be potentially related.

Obesity is the result of an interaction between genetics, environmental, metabolic, physiological, behavioral, and social influences. At is basic level it is an overconsumption of calories compared to the level of energy needed to sustain the individual. Currently the prevalence of overweight and obesity in adults is nearly 140 million Americans (66% of the population) which is a significant increase from the 56% calculated in 1982. The World Health Organization gives four main reasons for classifying Overweight and Obesity. The first is that it provides a meaningful comparison of body weight status within and between populations. Second is that it identifies individuals and groups at increased risk of morbidity and mortality. Thirdly it identifies priorities for intervention at individual and community levels, and lastly; it establishes a firm basis for evaluating intervention strategies. Physical inactivity causes a variety of physiological effects that occur at a hormonal level, and greatly influence body composition. Some of the known hormonal effects include increased cortisol production,
while at the same time, decreased testosterone and somatotropin output. This causes an increase in adiposity and a decrease in the body’s lean tissue which has a higher metabolic rate (Tortora and Derrickson, 2010). Fat storage is also determined by one’s genetics. Men tend to store fat around the abdomen and trunk in an android fashion, whereas women store extra fat around the hips thighs and buttocks which is referred to as a gynoid shape. One’s secondary fat storage is determined by family history.

Another factor related to excessive weight gain is environment. People who do not have access to healthy foods, or places to be physically active have an increased risk of becoming overfat compared to those with easily accessible health foods, and places to participate in physical activity. This is a drastically different environment than our ancestors occupied which consisted of scarce food and abundant physical activity. Our ancestors developed “thrifty genes” which allowed them to store calories to survive in their environment. What saved their lives is now killing us due to the dramatic change in the abundance of food and the fact that practically no physical activity is required for survival in this day and age. Participating in regular physical activity appears to forestall the tendency to add excessive adipose tissue. Physical activity has a directly proportionate relationship with the amount of weight change in an individual.

Physical inactivity also appears to have a relationship with depression, and one’s overall outlook on life. Most people do tend to feel sad from time to time, but depression is defined as feelings of intense sadness, which include feelings of hopelessness, helplessness, and worthlessness that can last from many days to many weeks which can keep an individual from functioning normally. The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), which is used to diagnose mental disorders, states that
depression occurs when one has at least five of the following symptoms; a depressed mood during most of the day (especially in the morning), fatigue or loss of energy, feelings of worthlessness or guilt, impaired concentration or indecisiveness, insomnia or hypersomnia, a diminished interest or pleasure in almost all activities, recurring thoughts of suicide, a sense of restlessness or being slowed down, or significant weight loss or weight gain.

Similar to obesity, depression in individuals is influenced by a number of different factors including genes, environment, brain activity, lifestyle, psychology, and personality. Research has shown that on average, depressed people only exercise about half as much as people who aren’t depressed. Depression is greatly affected by a variety of different chemicals produced in the brain including serotonin, norepinephrine, and dopamine. Serotonin is a hormone and neurotransmitter, and has been found to be low in people with depression. A person with depression may have a shortage of serotonin receptor sites which causes the individual to absorb the serotonin too quickly. Decreased levels of norepinephrine seem to cause depression only in individuals that are already predisposed to it. It appears that when serotonin and norepinephrine levels are low, an individual is at the greatest risk for becoming depressed. The neurotransmitter dopamine is associated with reward and reinforcement. When levels of dopamine are low, one also increases their risk of depression.

Exercise has been shown to release feel good chemicals known as endorphins and neurotransmitters, reduce the immune system chemicals that can increase depression, and increase core body temperature which could have a calming effect. It appears that
exercise helps people gain self-esteem, take their mind off their worries, increase their energy, help get rid of built up stress and anxiety, and improve quality of sleep.

When one asks whether obesity causes depression, or depression causes obesity, it is similar to the chicken and the egg question. People who are obese may be more likely to become depressed because they experience themselves as in poor health and are dissatisfied with their appearance. People who are depressed may be more likely to become obese because of physiological changes in their hormone and immune systems that occur with depression. The connection between the two is due to psychological, social, hormonal, biological, and societal factors. The psychological factor involves obese people being self-conscious of their body which could lead to a low self-esteem. The social factor is due to the fact that if a person is scared to socialize because of their weight, the ensuing loneliness will cause that person to experience depression. One’s hormones change when they become obese by producing more of the “stress hormone” cortisol. This increased production of cortisol can lead to both obesity and depression. Biologically extra weight causes increased stress on bones, muscles, and joints which leads to being tired and in pain. This constant painful stimulation contributes to depression. In our society, there is a huge pressure to be thin. Bullying and the constant bombardment of thin, skinny people in the media could also factor into depression.

What this literature review examines is the role physical inactivity plays in physical and mental health. The first part of this review focuses on the relationship between physical inactivity and obesity. Part II of this literature review examines physical inactivity effects depression, Part III explores the relationship between obesity and depression, and Part IV explores all three variables simultaneously.
Part I. Physical Inactivity and Obesity

Lesser et al. does a cross comparison between various ethnic groups. The purpose of this study was to test the hypothesis that higher levels of visceral adipose tissue in persons of Chinese and South Asian origin versus European origin are associated with lower levels of physical activity. The researchers hypothesized that ethnic differences in visceral adipose tissue are due to ethnic differences in physical activity.

A total of 603 healthy men and women between the ages of 30 and 65 years that were of Chinese, European and South Asian origins that were recruited from Vancouver Canada. The target for the upper range of a BMI was greater than 28 due to the fact that the researchers had difficulty identifying an adequate sample of Chinese participants in the highest BMI range.

Physical activity levels were assessed using the Modifiable Physical Activity Questionnaire which gave the subjects a range of leisure time physical activity options to choose from, and they recalled how often and for how long they participated in each activity over a one-year time frame.

In order to measure abdominal adipose tissue, the researchers used computerized tomography (CT) from a single cross-sectional CT scan centered at the L4/L5 intervertebral disc. Visceral adipose tissue was calculated as total pixels and area within the attenuation range that fell within the abdominal wall. Subcutaneous abdominal adipose tissue was calculated as the difference between total abdominal adipose tissue and visceral adipose tissue. They also used dual-energy X-ray absorptiometry to assess total body fat. To account for the ethnic differences present, the researchers used chi
squared tests for categorical variables and one-way ANOVA tests for continuous variables.

The results of this study showed that there were significant ethnic differences in all of the body composition and physical activity measures. The mean BMI for the Chinese was 25.8, for Europeans it was 27.8, and for South Asians it was 27.9. It was found that total body fat proved to be lowest in the Chinese, followed by the Europeans, and was highest in the South Asians. The Europeans had the highest amount of physical activity reported. The lower amounts of physical activity were associated with higher visceral adipose tissue in the Chinese and South Asians. Of the three groups, the South Asians seemed to be the most at risk for having higher visceral adipose tissue, and lower physical activity levels. The researchers found a consistent linear relationship between body fat distribution and physical activity in a correlational analysis.

Irving et al. designed an experiment to examine the effects of exercise training intensity on abdominal visceral fat and body composition in obese women with metabolic syndrome. In order to accomplish this, the researchers gathered twenty-seven middle aged women (average 51 years) who met the IDF criteria for metabolic syndrome. In order to meet this criteria the women had to have an elevated waist circumference that was greater than 80 cm. and at least two of the following conditions; elevated fasting blood glucose, low HDL-C, hypertriglyceridemia, and/or elevated blood pressure. Also, the subjects were sedentary at baseline.

The subjects’ body composition was measured using air displacement plethysmography. Also, computed tomography (CT) images were obtained at the L4-L5
intervertebral disc space to assess visceral adiposity and abdominal subcutaneous fat. The mid-thigh fat and muscle area were also assessed.

Before the study began, the subjects completed a continuous VO2 peak treadmill protocol. The initial velocity was set at 60 meters per minute and was increased by 10 meters per minute every three minutes until volitional fatigue. The VO2 peak was chosen as the highest VO2 attained during the exercise test. The lactate threshold was determined from the blood lactate-velocity relationship and was defined as the highest velocity attained prior to the curvilinear increase in blood lactate concentrations above baseline.

The subjects were randomized into one of three 16-week exercise conditions: no exercise training, low-intensity exercise training, or high-intensity exercise training. The no-exercise group maintained their current level of physical activity for the entire study. The low-intensity exercise group completed a 16 week supervised intervention. Their protocol consisted of five exercise sessions per week at an intensity that was at or below their determined lactate threshold. Also, the duration of each exercise session was adjusted based on each participant’s individual VO2-velocity relationship so that each participant expended 300 calories per training session during the first two weeks (this was performed 3 days a week), 350 calories during the third and fourth weeks (this was performed 4 days a week) and 400 calories per session for weeks 5-16 (this was performed 5 days a week).

The high-intensity subjects also completed a 16-week exercise protocol, but theirs was performed at moderate-high intensity. The participants were progressed to five exercise sessions per week by week five. Three days per week the subjects exercised at an intensity midway between the lactate threshold and VO2 peak and the remaining two
days they exercised at or below their lactate threshold. The calorie expenditures, velocity, and duration adjustments were made as described for the low-intensity group with the exception being that the participants always had three days a week exercising above their lactate threshold. All of the statistical analyses performed on these three groups were conducted using SAS software.

The results of the 16 week study showed that total abdominal fat and abdominal subcutaneous fat were significantly reduced in the high-intensity exercise group. No significant changes were observed in the control or low-intensity exercise groups. The high-intensity exercise group also significantly reduced body weight, BMI, percentage of body fat, fat mass, and waist circumference compared with the control and low-intensity exercise groups.

Geliebeter et al. addressed the controversy over which mode of exercise is most advantageous during weight reduction. They began their study by recruiting overweight men and women aged 19-48 who were currently sedentary. After randomizing the participants, the subjects were assigned to one of the following groups for a period of 8 weeks: 1) strength training and diet, 2) aerobic training and diet, or 3) diet only. Subjects received a liquid-formula diet that provided 70% of RMR, and were seen individually each week for 30 minutes of nutritional counseling. RMR was determined after the subject rested comfortably for 45 minutes in a supine position via open-circuit spirometry with a metabolic cart. The energy expended was calculated by indirect calorimetry. Mood was also assessed via the Beck Depression Inventory. A high score on this test indicated a more depressed mood.
Subjects assigned to either strength or aerobic training groups exercised under supervision three times per week on Monday, Wednesday, and Friday. The strength and aerobic exercise sessions were designed to be isoenergetic with a mean net energy expenditure of 150 kcal. Aerobic sessions lasted 30 minutes whereas the strength sessions lasted 60 minutes.

Subjects in the strength training group performed progressive-resistance weight training with Nautilus equipment. The following eight stations were used to exercise upper and lower body large muscle groups: leg extension, leg curl, chest press, super pullover, lateral raise, arm flexion, arm extension, and leg press. The first two sets consisted of six repetitions each, followed by a third set of as many repetitions as possible.

Subjects in the aerobic training group exercised first on a stationary leg cycle ergometer at a speed of 60 rpm at low resistance for 8 minutes. This was followed by 8 minutes on an upper-body ergometer with the arm cycling direction reversed each minute. Subjects concluded with leg cycling for 8 more minutes.

The data for all three groups were subjected to two-way analysis of variance (ANOVA) with repeated measures on one of the factors, pre- and post-intervention, to assess changes between groups and determine interactions.

The results showed that although the mean weight loss in the three intervention groups did not differ significantly, the strength-training group lost the least amount of FFM. None of the intervention methods were able to conserve RMR. Although none of the subjects were clinically depressed in this study, depression scores declined
significantly for all groups and declined significantly more in the exercise groups than in the diet only group despite losing equal amounts of weight.

**Part II. Physical Inactivity and Depression**

Farmer et al. presents a new observational find because it was the first indication from a prospective study of a large community sample that physical inactivity may be a risk factor for depressive symptoms. The studies that occurred before this one mostly examined small and highly selected samples which may not have represented the general population. The study investigated samples of the general population without major physical illness that might increase the risk for depressive symptoms. The relationship between physical activity and depressive symptoms was examined in healthy subjects aged 25-77 years. They attempted to address the following issues; first, is there a cross-sectional association between physical activity and depressive symptoms and is this association the same for men and women, blacks and whites? Second, does this cross-sectional association remain after controlling for possible confounders such as education, income, employment status, and self-reported health? Third, with which aspects of depressive mood is physical activity most associated? Fourth, does physical activity predict depressive symptoms and is the predictive value of physical activity the same for those depressed at baseline as it is for those not depressed at baseline?

The first National health and Nutrition Examination Survey (NHANES I) was conducted by the National Center for Health Statistics from 1971 to 1975 to the civilian population of the United States. Measures of depressive symptoms and physical activity were administered to 3,059 sample persons in the household. Participants also received a medical examination that included measurements of pulse, blood pressure, body weight,
height, and cholesterol. This follow-up study was done from 1982-1984 and attempted to interview NHANES I subjects. Ninety-three percent of all eligible subjects were successfully traced (3,016 out of 3,059). The researchers excluded individuals who reported certain health conditions either at baseline or follow-up. The conditions were excluded were those that could limit one’s physical activity. The subjects chosen were restricted to blacks and whites since the number of other racial groups was small. The end number of participants that were used in this observational prospective cohort study totaled 1,497 subjects.

The way the researchers measured depressive symptoms was the Center for Epidemiologic Studies Depression Scale (CES-D) which was designed to measure symptoms of depression in community settings. This scale has 20 items which ask for the frequency with which a given symptom was experienced during the previous week. The scoring was then reversed so that the high scores represented responses in the depressed range. The standard cutoff of 16 or more out of a total possible score of 60 was used as the measure of depressive symptoms.

The measurement of physical activity consisted of two questions asked at the baseline and follow-up. The first question asked respondents to estimate their amount of recreational physical activity, and the second asked about non-recreational physical activity.

In order to get an accurate representation of the population, the analyses were stratified by race and sex. Logistic regression was used for cross-sectional as well as prospective analyses to estimate the odds ratios for depressive symptoms.
The results for this observational study demonstrated a significantly larger proportion of those with depressive symptoms at baseline exhibited depressive symptoms at follow-up (43.5%) compared with the same proportion of those with no depressive symptoms at baseline (10.8%). Little recreational physical activity was more frequent among older subjects, blacks, those with less education, and those with lower income. For men, women, blacks, and whites, the researchers observed that there were greater odds of depressive symptoms for those at the lowest levels of physical activity. With this large community sample, a negative association was found in depressive symptoms and physical activity in recreation, which held up for both women and men.

Babyak et al. set out to assess the status of 156 volunteers with major depressive disorder (MDD) 6 months after the completion of a study in which they were randomly assigned to a four month course of aerobic exercise, sertraline therapy, or a combination of exercise and sertraline. The participants in this study were volunteers aged 50 years and older who met DSM-IV criteria for major depression disorder and scored at least a 13 on the HRSD at study entry. The subjects were considered to meet DSM-IV criteria for MDD if they exhibited either persistent depressed mood or loss of interest or pleasure plus the additional symptoms of sleep disturbance, weight loss or change in appetite, psychomotor retardation or agitation, fatigue or loss of energy, feelings of worthlessness or excessive guilt, impaired cognition or concentration, or recurrent thoughts of death, for a total of at least five symptoms. After the subjects had completed their baseline assessment, the participants were randomly assigned to one of three treatments: 1) exercise 2), medication, or 3) combined exercise and medication.
The exercise subjects attended three exercise sessions per week for 16 consecutive weeks. The subjects were assigned training ranges that were equivalent to 70% to 85% of their heart rate reserve. Each aerobic session began with a 10-minute warm-up period, followed by 30 minutes of continuous cycle ergometry or brisk walking/jogging at an intensity that would maintain heart rate within the assigned training range. The session then concluded with 5 minutes of cool down exercises.

The subjects in the medication group received sertraline (Zoloft) which is a selective serotonin-reuptake inhibitor. The medication was selected because of its documented efficacy and favorable side effect profile for the elderly. The medication was provided by a staff psychiatrist who met with each patient at the start of the study and again during weeks 2, 6, 10, 14, and 16. The psychiatrist would then evaluate the treatment response and side effects at these meetings and adjust the dose of the medication accordingly. The treatment began with 50 mg and was titrated until a well-tolerated therapeutic dosage was achieved up to 200 mg.

The third group that consisted of the combined exercise and medication received the same exercise regimen as the first group, and the same medication dosages as the second group. The subjects in all three groups were classified as being in full remission if they no longer met criteria for MDD and had an HRSD score <8 after four months of treatment. A classification of recovery was used if they continued to remain in full remission for > 6 months. A partial recovery classification was given to subjects who did not meet criteria for MDD but still exhibited significant depressive symptoms as reflected by an HRSD score of >7 but <15. Participants were considered to have a relapse if they were initially considered in remission after four months of treatment but were found at
the 6-month follow-up visit to meet DSM-IV criteria for MDD or to have an HRSD score of ≥ 15.

The 6-month follow-up assessment was available on 133 out of the original 156 enrolled patients. The results showed that participants in the exercise group exhibited lower rates of depression (30%) than participants in the medication (52%) and combined groups (55%). The subjects in the exercise group were more likely than those in the medication group to be partially or fully recovered at the six month follow-up visit. Also, only 8% of remitted patients in the exercise group had relapsed, compared with 38% in the medication group and 31% in the combination group. These results show that exercise is a feasible therapy for patients suffering from MDD and may be at least as effective as standard pharmacotherapy.

What was most interesting about this experiment was that combining exercise with medication demonstrated no additional advantage over either treatment alone. In fact, the opposite proved to be the case, at least with respect to relapse rates for patients who initially responded well to treatment. The reasons for this outcome are open to speculation, although it was apparent that there may have been some “antimedication” sentiment among some study participants, which was evidenced by expressions of disappointment when they were told they would be assigned to a group that would receive medication in addition to exercise. Some subjects in the combination group also mentioned that the medication seemed to interfere with the benefits of the exercise. Although physiologically this is unclear, the explanation may be due to psychological factors. One positive psychological benefit of exercise is the development of a sense of personal mastery and positive self-regard which plays a role in the depression-reducing
effects of exercise. Also, self-reported exercise during the follow-up period was inversely related to the incidence of depression.

Dimeo et al. evaluated the short term effects of a training program on patients with moderate to severe depression. They began by selecting 12 patients who had been diagnosed as suffering from major depressive disorder according to DSM IV criteria. Further inclusion criteria for the chosen subjects were age between 20 and 65 years, no change in treatment in the six weeks preceding the training program, and a score of 15 or more on the Hamilton Rating Scale for Depression (HAMD). Maximal physical performance was assessed at the beginning and end of the study with a modified Bruce treadmill test under continuous EKG monitoring. The test was carried out until subjective exhaustion.

The training consisted of daily walking on a treadmill; it was started on Mondays and carried out for the following 10 days with breaks on Sundays. The program was designed according to an interval training pattern. Subjects carried out five training bouts of three minutes each; the intensity of effort corresponded to a lactate concentration of 3 (0.5) mmol/l in capillary blood. Between training bouts, patients walked at half speed for three minutes to recover. Intensity was evaluated using the Borg Rate of Perceived Exertion scale.

Severity of depression was rated at the beginning and end of the program by a psychiatrist using the HAMD. Patients rated their mood daily using a visual analogue scale, ranging from 0 (“I feel bad”) to 10 (“I feel good”) with the Scale for Self-assessment of Depression (D-S)A response to therapeutic intervention was defined as a
reduction of 50% or more or a final score of 10 or less on the HAMD. All statistics were carried out with the GraphPad Prism 3.00 for Windows.

The results showed that depression scores were significantly reduced at the end of the training program in both the objective psychiatric evaluation and the subject assessment of symptoms. These results showed that aerobic training can produce a substantial improvement in symptoms in a short time.

Stein and Motta compared nonaerobic and aerobic exercise in a nonclinical population to ascertain whether they differentially affect depression and self-concept measures. They selected 89 subjects (average age of 20) from a private university in Nassau County, New York. The subjects were then enrolled in a swimming class (aerobic group), a weight-training class (anaerobic group), or an Introduction to Psychology class (control group). To measure depression, the researchers had a colleague who was blind to the hypotheses meet with three swimming class sessions, three weight-training sections, and three Introduction to Psychology classes during the first week of classes. The students filled out an exercise history and background questionnaire, the Beck Depression Inventory, the Depression Adjective Check Lists, and the Tennessee Self-concept Scale. On the final day of class, the subjects were administered the exercise history questionnaire to ensure inclusion criteria, and the depression and self-concept scales for a second time.

Each of the exercise classes met two times a week for about 90 minutes. The students met a total of 14 times in seven weeks. The aerobic exercise group involved students in a structured “Swimming for Fitness” class design. Each of these sessions began with a ten minute warm-up followed by a 60 minute period of swimming, and
concluded with a ten minute cool-down. The students in this group swam numerous laps for several minutes with only short breaks in-between. The Cooper’s “Twelve Minute Swim” was conducted on the first and last days of class to monitor progress. The students were taught how to monitor their own heart rate and swam at their optimal heart rate for at least fifteen to twenty minutes. The heart rate was calculated by subtracting the subjects age from 220 and multiplying that by .70 and by .85.

The anaerobic exercise condition required the subjects to engage in the structured Progressive Training Exercises using both free weights and the machines. Each session began with a ten minute warm up, followed by 60 minutes of weight lifting, and ended with a ten minute cool down. The students in the Introduction to Psychology class (control group) did not perform physical exercise.

The results showed that the anaerobic group exhibited a higher over-all self-concept than both the aerobic and control groups, although the aerobic group showed improvement also. The researchers explained that by participating in an exercise regimen, the participants may perceive themselves as attaining mastery on a graded task. Gains in strength, muscle girth, flexibility, or cardiovascular efficiency could suggest to participants that they are gaining personal control over their environment. The fact that the weight-training group improved the most on self-concept may be tied to perceptions about one’s body and physical appearance.

Singh et al. tested three various hypotheses in regards to depression: 1) Progressive resistive training (PRT) exercise is an effective antidepressant in older adults with clinical depression; 2) high intensity PRT is superior to low intensity exercise; and
3) high intensity PRT is superior to standard general practitioner (GP) care of depression in older adults.

This study was a randomized controlled 8-week study comparing the effects of assignment to one of three interventions for clinical depression: two exercise interventions (high intensity PRT (HIGH) and low intensity PRT (LOW) and a usual care group getting standard GP care. The participants included were aged greater than 60 years; fulfilled DSM-IV diagnostic criteria for major depression, minor depression, or dysthymia; and had a Geriatric Depression Scale (GDS) score of greater than 14.

Participants assigned to HIGH underwent a regimen of supervised high intensity PRT of the large muscle groups, 3 days per week for 8 weeks. The exercise machines included chest press, upright row, shoulder press, leg press, knee extension, and knee flexion. The resistance was set at 80% of the one repetition maximum (1RM) on each machine. To maintain the intensity of the stimulus, the load was increased at each session so that the perceived exertion assessed by the Borg scale ranged between 15 and 18 on the 20 point scale. Participants performed 3 sets of 8 repetitions on each machine. The LOW group underwent low intensity resistance using the exact same regimen, except they were trained at 20% 1 RM and not progressed. All participants not randomly assigned to resistance training received usual care from their GP.

The results of this study suggested that high intensity weight lifting is an effective, feasible, and safe treatment for older depressed patients. High intensity PRT was more effective than low intensity PRT and GP care. There was no statistically significant difference in efficacy between low intensity exercise and standard care. Compared to standard antidepressant treatment of elderly persons, high intensity
resistance training appears to offer similar efficacy, with a clinically meaningful response seen in approximately 60% of this study.

Suija et al. examined the association between physical fitness and depressive symptoms in young adults. The aims of this study were to determine the cross-sectional associations between: 1) physical activity and depressive symptoms, and 2) physical fitness, including both cardiorespiratory and muscular fitness and depressive symptoms among young adults.

The study population consisted of 5,497 males and females, members of the Northern Finland birth cohort of 1966, who at age 31 completed fitness tests and filled in a questionnaire including questions about depressive symptoms and physical activity. The depressive symptoms were obtained through Hopkins’ Symptom Checklist-25 (HSCL-25) which is a 25-item shortened version of an originally 90-item questionnaire designed by Derogatis et al. Cohort members recorded their estimates of the severity of their depressive symptoms on a scale ranging from 1 (“not at all”) to 4 (“extremely”). The average of these scores was then found and compared to two commonly used mean scores of 1.55 and 1.75. These points are cut off points for important depressive symptoms but not for diagnosis of major depression.

Physical activity was assessed by asking subjects how often they participated in light and brisk physical activities. Response alternatives were daily, four to six times a week, two or three times a week, once a week, two to three times a month, and once a month or less often. The duration of one bout of activity was considered separately for light and brisk activities with the following alternatives: more than 90 minutes, 60-90 minutes, 40-59 minutes, 20-39 minutes, less than 20 minutes, and not at all. Total volume
of physical activity was expressed as metabolic equivalent hours/week, which was formed by calculating the duration and frequency of both brisk and light physical activity. An intensity value of 3 METs was used for light physical activity and 5 METs for brisk physical activity. Five equally distributed categories to describe quintiles of physical activity were then formed.

Cardiorespiratory fitness was measured by a submaximal four minute single step test conducted on a 33 cm bench (females) or a 40 cm bench (males), with a metronome paced rate of 23 steps per minute. Heart rate after the step test was the indicator of cardiorespiratory fitness, which was measured after the test by a heart rate monitor handle on the chest.

Muscular fitness was measured by trunk extension and maximal isometric handgrip tests. The trunk extension test had the subject in a prone position, the lower body lying on the stand and the upper body unsupported from the level of the anterior superior iliac spine upwards. The isometric endurance capacity of the trunk extensor muscles was evaluated by holding the upper part of the body in a horizontal position for as long as possible, however, not exceeding four minutes.

Maximal isometric handgrip strength of the dominant hand was measured with a hand dynamometer. The subject was tested in a standing position with the wrist and elbow extended. The highest value of three trials was recorded.

The prevalence of depressive symptoms was compared in quintiles groups of physical activity and fitness. Odds ratios with 95% confidence intervals were calculated for having depressive symptoms by different quintiles of physical activity and fitness.
The results showed that low level of isometric endurance capacity of trunk extensor muscles is associated with high level of depressive symptoms in both sexes. In males, also poor handgrip strength is associated with increased levels of depressive symptoms. The physical activity level was inversely associated with the prevalence of depressive symptoms among young adults.

Part III. Obesity and Depression

Sjoberg et al. wanted to use the SALVe-2004 to answer the question of whether BMI, obesity, and depression are associated in an adolescent population-based sample and whether experiences of shame and psychosocial and economic status can explain such a possible association. The SalVe-2004 is a survey that is regularly distributed by the County Council of Vestmanland to monitor the psychosocial health of the adolescent population of the county.

The researchers looked at 2,679 15-year-olds (1,357 boys and 1,322 girls), and 2,024 17-year-olds (1,033 boys and 991 girls). The total subject base was 4,703 individuals. They used self-reports of BMI to assess obesity, and drew the cutoff line at 25 for being overweight, and 30 for being obese. Depressive symptoms were measured using the DSM-IV criterion, whereas shame, psychosocial, and economic status were assessed using five questions. The questions were: “Have you during the latest period of 3 months experienced that someone: 1) treated you in a degrading manner? 2) made fun of you in front of others? 3) questioned your sense of honor? 4) talked about you in a degrading manner? 5) ignored you or behaved as if you did not exist? The answers were given on a five point scale: 1, no never; 2, rather seldom; 3, sometimes; 4, rather often; and 5, almost always. The 25% who reported the lowest number of shame experiences
were categorized as the low-shame group. Those who reported such experiences between 26% and 75% of the time formed the intermediate group, and the remaining individuals formed the high-shame group.

The results of this study showed that boys were significantly more overweight and obese in both age groups, whereas girls were more depressed according to DSM-IV criterion. They also found that individuals who belonged to the obese group significantly suffered more often from major depression according to the DSM-IV criterion. Obesity was also associated with experiences of shame (such as experiences of being degraded or ridiculed by others).

Although this study showed a strong correlational relationship, causation cannot be determined due to its cross-sectional nature. Another limitation is that it is entirely based on self-reports, so response biases could not be controlled for. The researchers also admitted that they used a very sensitive measure of depression which may have made trends easier to discover, but could have also led to an overestimation of the prevalence of depression in this population. The researchers believe however, that these limitations were overcome by the large sample size of subjects. The sample used in this study was much larger than previous studies, and they measured and controlled for a number of relevant confounders so that they could clearly observe the relationship between obesity and depression.

Sjoberg et al. shows that shame mechanisms may be activated by cues of physical appearance such as obesity, which may become a stigmatizing feature and put adolescents at psychological risk. It also shows that treating obesity may not be just a matter of diet and exercise but also of dealing with issues of shame and isolation.
Goodman and Whitaker showed that depressed mood in adolescence is associated with an increased risk for the development and persistence of obesity over one year. They designed a prospective cohort study of 9,374 adolescents in grades 7-12 who completed in-home interviews for the National Longitudinal Study of Adolescent Health. That data for this study were drawn from the National Longitudinal Study of Adolescent Health, and used data from the weighted in-home sample at baseline (Wave 1 in April-December 1995) and first follow-up (Wave 2 in April-August 1996). The sample criteria for the subjects were those who 1) were < 20 years old in wave 1; 2) completed the in-home interviews in both waves, 3) had biological, step, foster, or adoptive parent who completed an in-home interview at Wave 1; and 4) provided self-reported height and weight in both waves.

Obesity was defined as a BMI greater than or equal to the 95th percentile for age, gender and overweight as a BMI greater than or equal to the 85th percentile but less than the 95th percentile. Depression was identified by using a slightly modified version of the Center for Epidemiologic Studies Depression Scale (CES-D). Descriptive statistics were generated with SPSS version 10.

The results showed that at baseline, 12.9% were overweight, 9.7% were obese, and 8.8% had depressed mood. Baseline depressed mood was not significantly associated with baseline obesity. Obesity at follow-up was present in 79.7% of those obese at baseline, 18.5% of those overweight at baseline, and 1.8% of those who were normal weight at baseline. Among those obese at baseline, linear regression analyses revealed that baseline depressed mood also predicted BMI z score at follow-up.
Goodman and Whitaker concluded from this nationally representative cohort that depressed mood at baseline was associated with the development of obesity in those not yet obese at baseline and with an increase in age-adjusted BMI in those already obese at baseline. The limitations of this study were caused by self-reported BMI. Those obese at baseline may underreport their BMI at follow-up, and they may do so more if they are more obese at baseline. The strengths of this study were the number of subjects, and the prospective cohort design used.

To understand the effects obesity could have on depressions throughout one’s lifetime, Herva et al. examined the association between body size and depression in a longitudinal setting. Their mission was to explore the connection between obesity and depression in young adults at the age of 31 years. They used a longitudinal setting in the Northern Finland 1966 Birth Cohort study (NFBC). They first evaluated whether obesity in adolescence (at the age of 14 years) predicts depression in young adulthood (at the age of 31 years). Next, they went about exploring whether depression is more common among the obese than among those with normal weight at the age of 31 years.

The follow up studies to the NFBC study were performed at the ages of 14 and 31 years. At the age of 14 years, the follow-up study was conducted by postal inquiry only, whereas at the age of 31 years, both postal inquiry and clinical examination were utilized. They had 10,096 subjects at the 14 year follow-up, but lost 2,584 of them at the 31 year follow-up.

The researchers measured overweight and obesity by using the BMI scale. Obesity was defined as having a BMI at or above the 95th percentile. The subjects reporting proved to be accurate, because in 70% of the subjects whose height and weight
were measured, the measurements taken by the researchers and the subjects own self-reports were almost identical (the correlation was 0.98). The researchers then studied weight change by dividing the subjects into three groups. The first was always overweight or obese at the ages of both 14, and 31 years; the second was those who had gained weight, who had normal weight at the age of 14 years but became overweight or obese at the age of 31 years; the third group was considered “the others” who had a normal weight at both age 14 and 31 years.

Depression was defined in three different ways at the 31 year follow-up. Current depression was assessed by the HSCL-25-depression questionnaire which is a 25-item shortened version of the questionnaire designed by Derogatis et al. This questionnaire contained a 13-item depression subscale which assessed the presence and intensity of depressive symptoms during the previous week. The second way depression was measured was whether or not the subjects were currently taking an antidepressant medication; and thirdly, whether or not the subjects had ever been diagnosed as having depression by a physician. Potential confounders that were identified included socioeconomic status, marital status and family type, chronic somatic diseases, smoking, use of alcohol, physical activity, and dietary habits. These confounders were statistically accounted for by using SPSS software.

The results of this study showed that teenage obesity predicted depression in young adults. Obesity and especially abdominal obesity among male subjects was associated with depression in adulthood and being overweight/obese at both 14 and 31 years was associated with depression among female subjects. This particular study gives the assumption that obesity predicts later depression. Since body image develops at
adolescence, at that age overweight or obesity may easily have a negative influence on subjective well-being. Another interesting find was that at a cross-sectional setting (when the patients were measured at 31 years) men who were classified as underweight according to the BMI chart were more commonly depressed than those with normal weight. The conclusion the researchers came up with for this phenomena was that “being underweight and male may have a special psychological meaning: men may prefer a large, muscular body rather than a thin one, and having a low body weight may be associated with a poorer body image which could increase the risk for depression.”

The researchers also believed that the connection between abdominal obesity and depression in men may be due to cortisol secretion. As a way to cope with this stress some individuals may be prone to consume alcohol and to eat unhealthy foods, which also lead to abdominal obesity and depression. It was also noted that physical inactivity is closely related to the development of abdominal obesity and that it may decrease psychological well-being.

This study concluded that obesity in adolescence might be associated with later depression among female subjects, abdominal obesity among male subjects may be closely related to depression, and being overweight/obese both in adolescence and adulthood may be a risk for depression among female subjects. They also suggested that more longitudinal studies are needed to explore the connection between obesity and depression.

In order to verify the apparent connection between obesity and depression, Simon et al. used a nationally representative sample of US residents to evaluate the relationship between obesity and a range of mood, anxiety and substance use disorders in the US
The researchers used the NCS-R which was an in-person survey of a nationally representative sample of US residents conducted between February 5, 2001, through February 12, 2003. Participants in this study received $50 for participating. All the assessments were conducted by professional non-clinician interviewers from the Institute for Social Research at the University of Michigan. The mental disorders were assessed using the World Mental Health version of the World Health Organization Composite International Diagnostic Interview. The mental disorder diagnoses were based on criteria of the DSM-IV. The demographic characteristics were assessed by participants’ self-reports, and all analyses were based on weighted data and implemented using SUDAAN statistical software.

The results of this study showed that those with higher BMIs on average were African American or Hispanic and were less likely to have completed more than 12 years of education. The lifetime prevalence estimates for mood and anxiety disorders were all higher among those with BMIs of 30 or more. Interestingly enough, the association between obesity and mood disorder was only statistically significant among respondents with more than 12 years of education. The sociodemographic groups that displayed the strongest association between obesity and depression were those who were less than 29 years, college educated or higher, non-Hispanic whites and were also among the groups with the lowest prevalence of obesity. Other results showed that smoking is positively associated with psychiatric disorder, yet negatively associated with obesity.

Kolotkin et al. researched the impact of weight on quality of life. In order to do this the authors developed a questionnaire that would reliably and validly measure the extent to which weight affects quality of life. The aim of this study was to be able to
determine the aspects of quality of life that are most affected by weight and to measure improvements in quality of life that are associated with weight loss or other treatment interventions.

The first part of the study evaluated the reliability of their survey; the Impact of Weight on Quality of Life (IWQOL) questionnaire. The subjects included 64 outpatients (37 women, 27 men) in a treatment for obesity at Duke University Diet and Fitness Center (DDFC). The mean age of the subjects was 45 years. The following eight scales, along with the number of questions in each scale were assessed: Health (14), Social/Interpersonal (11), Work (7), Mobility (10), Self-Esteem (10), Sexual Life (6), Activities of Daily Living (7), and Comfort with Food (9). The subjects were administered the questionnaire at three points in time: day 1, day 2, and day 28 of the treatment program. The treatment program lasted 28 days.

The results of the first study indicated that the psychometric properties of the IWQOL are within acceptable ranges. The item and scale scores appeared to be stable, and items within scales tended to be internally consistent.

After determining that their questionnaire was stable, the researchers set about examining the effects of BMI, gender, and age on subjects’ perceptions of impact of weight on quality of life. The subjects were 181 outpatients (117 women and 64 men) in treatment for obesity at Duke University Diet and Fitness Center. The average age was 48.7 and the average BMI was 38.3. The IWQOL was administered on day one of the treatment program.

This second study tested the following three hypotheses: 1) The impact of weight on quality of life would be greater for heavier than for less heavy subjects, 2) Weight
would have a greater impact on quality of life for women as compared to men, and 3) With increasing age, weight would exert less impact on quality of life in the areas of Self-Esteem and Social/Interpersonal.

The results of the second study indicated that the initial hypotheses regarding the relationships between impact of weight and BMI, gender, and age held true. As predicted, the impact of weight on quality of life generally worsened as the patients’ size increased. For men, there was a positive correlation between increasing size and impact of weight on all areas except Work and Comfort with food.

With respect to Self-Esteem and Sexual Life, the relationship between BMI and impact of weight for women was more complex. Even at the lowest BMI tertile, women reported that weight had a substantial impact on perceived quality of life in these areas. It was also found that women experienced the effects of their weight more profoundly than did men in the areas of Self-Esteem and Sexual Life after controlling for BMI.

Simon et al. observed significant positive associations between obesity and a range of mood and anxiety disorders in a nationally representative sample of the US household population, yet in contrast, substance use disorders were associated with a significantly lower risk of obesity. Having BMI scores greater than 30 showed to put obese individuals at a 24% greater risk of having a mood disorder. This means that more than one fifth of cases of mood disorder in the general population are attributable to the association with obesity.

The NCS-R offered several advantages when used to examine associations between psychiatric disorders and obesity. First, the sample was an accurate representation of the non-institutionalized population of the United States. Second,
mental disorders were assessed using a well-validated structured diagnostic interview which allowed the association of obesity with these disorders to be assessed with accuracy. Third, the assessment considered lifetime diagnoses and current state.

In this study, the associations between obesity and psychiatric disorders did not vary between men and women which contradict previous findings in other US national surveys. Other surveys have found positive associations between obesity and depression in women, whereas absent associations were found in men. Associations in this study appeared stronger in younger, non-Hispanic whites and in respondents with a higher educational attainment. Also, the groups that showed the strongest association between obesity and mood disorder were also the groups with the lowest overall rates of obesity. The researchers then concluded that obesity is meaningfully associated with a range of common mood and anxiety disorders in the general US population, and a moderately lower risk of substance use disorder. Additional research on the relationship between obesity and mood or anxiety disorders will require populations with a broader range of race/ethnicity, educational attainment, and income. Longitudinal and experimental studies will be necessary to clarify the direction of causal relationships between these two variables.

Luppino et al. conducted a systematic review and meta-analysis on the longitudinal relationship between depression, overweight, and obesity to identify possible influencing factors. This meta-analysis examined whether depression is predictive of the development of overweight and obesity and, in turn, whether overweight and obesity are predictive of the development of depression.
A systematic computerized literature search of PubMed, EMBASE, and PsycINFO was performed for studies in English up to March 2008. Studies presenting solely cross-sectional analyses were excluded as well as case reports, comments, letters, and reviews. Articles with a follow-up period of less than one year, not expressing weight as BMI, or not specifying the way depression was assessed were also excluded.

The quality of all included studies was assessed by using a 15-item checklist adapted from Kuijpers et al. Each item was indexed with a (+) score (= 1 point) or a (-) score (= 0 points). An article was defined as “high quality” when it scored 60% or more of the maximal possible score. Data management, transformation of effect sizes, and calculation of the pooled mean effect sizes were performed using Comprehensive Meta-analysis (CMA) version 2.0.

The researchers found bidirectional associations between depression and obesity: obese persons had a 55% increased risk of developing depression over time, whereas depressed persons had a 58% increased risk of becoming obese. The association between depression and obesity was stronger than the association between depression and overweight, which reflected a dose-response gradient.

Lutter and Elmquist did a review of existing research that linked depression and metabolism. They found that in addition to increasing the risk of becoming obese, major depressive disorder (MDD) is frequently associated with other comorbidities, including the metabolic syndrome, atherosclerosis, and diabetes.

Their review of current literature also examined studies looking at the hormone leptin. Leptin, a hormone produced by adipose tissue, is well known for regulating food intake and body weight. Lutter and Elmquist’s review reported a reduction in leptin levels
after chronic unpredictable stress (CUS), a rodent model of stress-induced anhedonia. Furthermore, acute administration of leptin reversed the deficits observed in sucrose preference after CUS. Leptin deficiency also blunted the locomotor response of mice to amphetamine injection. They suggested that future studies should determine whether a stress-induced decrease in leptin and increase in ghrelin signaling contribute to the development of obesity.

Carpenter et al. sought to test the relationships between relative body weight and clinical depression, suicide ideation, and suicide attempts in an adult US general population sample. They set out to find the answers to the following questions: (1) is relative body weight positively associated with clinical depression, suicide ideation, and suicide attempts? (2) Is relative body weight’s association with major depression, suicide ideation, and suicide attempts different for men and women? (3) Is relative body weight’s association with major depression, suicide ideation, and suicide attempts different for Whites and African Americans?

This study was based on the 1992 National Longitudinal Alcohol Epidemiologic Survey (NLAES), which involved face–to-face interviews of 42,862 household residents 18 or older in the United States. The final sample size for this study was 40,086 people. The Alcohol Use Disorders and Associated Disabilities Interview Schedule (AUDADIS) was used to assess major depression, suicide ideation, and suicide attempts. The AUDADIS diagnosis of major depression requires the presence of a chronic and persistent depressed mood for at least 2 weeks. Height and weight were self-reported, with a BMI of 20.77 or less classifying underweight, 30 or more obese, and an average
weight was defined as a BMI between 20.78 and 29.99. SUDDAN was used for all statistical analyses.

The results of this study indicated a U-shaped relationship such that relatively high and low BMI values were associated with an increased probability of past-year major depression. The results also indicated that the relationship between relative body weight and clinical depression and suicidal tendencies was different for men and women. Obesity was associated with an increased risk of depression among females but a decreased risk of depression among males. Among women, obesity was associated with a 37% increase in the probability of being diagnosed with major depression, while for men, obesity was associated with a decrease of similar magnitude. The intriguing finding among men was the association between being underweight and having an increased probability of clinical depression and suicidal tendencies. Underweight men were 81% more likely to have thought about suicide, 77% more likely to have attempted suicide, and 25% more likely to be clinically depressed than average weight men.

**Part IV. Physical Inactivity, Depression, and Obesity**

The final component of this review examines studies that have included the three variables of obesity, physical inactivity, and depression, and how these variables may be correlated to one another.

Konttinen et al. set out to examine direct and indirect associations between depressive symptoms, emotional eating, physical activity self-efficacy, and adiposity indicators. The participants took part in two phases of the National Cardiovascular Risk Factor survey (The FINRISK Study) that was conducted in 2007. A random sample of people aged 25-74 was drawn from the Finnish population register in five geographic areas. This sample
was then stratified by sex, ten year age group, and area. The participants received a self-administered health questionnaire that included questions about sociodemographic factors, health behaviors, and medical disease histories. All 6,258 subjects who participated in the first study were invited to continue in the second phase which aimed to investigate the dietary, lifestyle, and genetic determinants of obesity and metabolic syndrome. The response rate to the second phase was 84% (2,325 men and 2,699 women). These subjects completed questionnaires concerning psychosocial factors in the course of a health examination that measured their weight, height, waist circumference, and percentage of body fat.

Depressive symptoms were measured with the self-report 20 item Center for Epidemiologic Studies- Depression Scale (CES-D). The emotional eating scale of the shortened and revised 18 item Three-Factor Eating Questionnaire (TEFQ-R18) was used to assess emotional eating. The emotional eating scale consisted of three items: 1) when I feel anxious I find myself eating; 2) when I feel blue I often overeat; and 3) when I feel lonely, I console myself by eating. These items were rated on a four-point scale with 1 not describing the participant at all; to 4 describing the participant exactly.

The physical activity self-efficacy was assessed as the individual’s confidence in his or her ability to overcome different emotional and other barriers to maintain physical activity behaviors. The scale used the following phrase: most people have various kinds of plans and ways to exercise. However, it is sometimes difficult to follow these intentions because of various difficulties. How certain are you that you could overcome the following barriers? The 5 barriers included in the scale were as follows: I can manage to carry out my exercise intentions even when I 1) have problems and worries, 2) am
busy, 3) am depressed, 4) am tired, and 5) am tense. These items were rated on a four-point scale from 1 being very certain to 4 being very uncertain.

The results showed that approximately 20% of men and 23% of women were obese, and 29% and 42% had central obesity. The average body fat percentage was 24.9%. It was shown that women had higher depressive symptoms and emotional eating than men, but scored lower than men on physical activity self-efficacy. The depressive symptoms and emotional eating were positively correlated, and physical activity self-efficacy was negatively correlated with BMI, waist circumference, and percentage of body fat in both sexes. Elevated depressive symptoms were associated with higher emotional eating and lower physical activity self-efficacy whereas emotional eating and self-efficacy were negatively correlated with each other. Emotional eating was also related to higher BMI, waist circumference and percentage body fat. The relations between depressive symptoms, emotional eating, physical activity self-efficacy, and BMI in the three age groups were not significantly different. The associations of physical activity self-efficacy, did however, significantly differ between the sexes: it had a weaker negative association with depressive symptoms and stronger negative associations with emotional eating and BMI in women than in men. Higher age, lower education, chronic diseases, higher emotional eating, and lower physical activity self-efficacy were significant predictors of obesity, central obesity, and percentage body fat.

Konttinen et al. claims to be the first study to examine whether psychological factors related to eating and physical activity behaviors are mechanisms through which depressive symptoms are associated with higher adiposity indicators. It was noted that elevated levels of depressive symptoms were related to a higher tendency to eat during
negative emotions and lower self-efficacy in maintaining physical activity behaviors when facing barriers. Also, depressive symptoms and emotional eating were associated with a higher BMI, waist circumference, and body fat percentage, whereas physical activity self-efficacy had an inverse association with these adiposity indicators. These findings were consistent in men, women, age, and education groups.

**Summary**

The review of various articles describing the relationships between physical inactivity, obesity, and depression, has revealed that all three variables can potentially contribute to one another. This is an interesting turnaround from the ‘Jolly Fat’ hypothesis presented in the 1970s, when a positive association was found between obesity and low levels of anxiety in men and women, and low levels of depression in men (Herva, et.al. 2006). Researchers now believe this is not the case, which illustrates the importance of continuing research on the topic.

The influencing factors on physical inactivity, obesity, and depression that research has found include socioeconomic status, education level, race, and gender. These factors all contribute to the way one feels in regards to depression, becoming obese, and maintaining adequate activity levels. This is shown in the previous articles which demonstrated that the least at risk population for becoming obese (educated, non-Hispanic white middle-upper class individuals) are actually psychologically the most effected by obesity in terms of depression.

The interactions between obesity, depression, and physical activity present a unique challenge for individuals in the health field trying to figure out ways to counter the obesity epidemic. Not only must health practitioners’ address calories-in vs. calories-out
as previously thought, but intervention strategies must also include psychosocial methods that address an individual’s possible depression. The review of ten articles on the subject have shown that depression and stress can lead to increased levels of cortisol secretion and that emotional eating habits are potentially used to combat this stress. The emotional eating could lead to obesity, and from there a negative body image combined with the depression may render an individual physically inactive. Since depression and obesity appear to have a bidirectional relationship, it must also be noted that obesity could also lead to depression.

Depression and obesity are prevalent worldwide and are among the leading public health concerns in industrialized countries. Continuing research has shown that one of the most effective ways to go about addressing these concerns is with regular physical activity. In order to render an individual physically active, emotional eating interventions and physical activity self-efficacy strategies should be utilized for promoting healthy eating habits and a physically active lifestyle for the prevention of weight gain in depressed individuals. This in turn should show alleviations in individuals who are depressed. Combating physical inactivity should show great improvements in obesity and depression in individuals independent of their race, age, or gender.
References


The following appendix is a list of the questions asked during the depression health risk appraisal portion of the Trifit testing protocol. Students answered each question with a number corresponding with a statement. These numbers were as follows; 1) Almost never, 2) Sometimes, 3) Often, 4) Almost always. Listed below are the questions that the students answered.

1. I feel blue or sad
2. I feel confident and hopeful about the future
3. I feel like a failure
4. I don’t enjoy things the way I used to
5. I feel guilty
6. I have a feeling something bad may happen to me
7. I am pleased with myself
8. I blame myself for everything that goes wrong
9. I have crying spells
10. I get irritated or annoyed
11. I am interested in people and enjoy being with them
12. I am unsure of myself and try to avoid decisions
13. I feel that I look attractive and healthy
14. I sleep poorly and am tired in the morning
15. I am energetic and eager to take on new tasks
16. My appetite is not as good as it used to be
17. I am as interested in sex as I used to be
18. I am concerned about my stomach and my bowels
19. I feel healthy
20. I have trouble doing my work